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FRACTURE OF THE SPINE :
ITS IMMEDIATE TREATMENT
BY RECTIFICATION OF THE DEFORMITY
AND FIXATION BY
PLASTER OF PARIS JACKET.

SURRELL.



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FRACTURE OF THE SPINE: ITS
IMMEDIATE TREATMENT
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AND FIXATION BY
PLASTER OF PARIS JACKET.

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Read at the Annual Meeting of the Massachusetts Medical Society,
June 7, 1887.



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FRACTURE OF THE SPINE : ITS IMMEDIATE TREATMENT BY RECTIFICATION OF THE DEFORMITY AND FIXATION BY PLASTER OF PARIS JACKET.

FROM a practical point of view, we may consider dislocations and fractures of the spine together, and it will not be a difficult task to represent to the minds of most surgeons the utter hopelessness of this injury in most cases.

All authorities¹ agree that the prognosis depends largely upon the location of the injury, and the amount of damage done to the spinal cord. It is not the injury to the bony structures or ligamentous union, that renders this injury so fatal, but the pressure or crushing that takes place of that wonderfully constructed spinal cord, which receives and transmits impressions to the various members of the body.

The spine itself is so complexly constructed, adapted to so many different movements and purposes, that we can really say, that when it receives an injury, the "back bone" of the human organism is broken.

The cord resting as it does in a bony canal, may be pressed upon by bony spiculae from any side, it may be pressed upon or severed completely by some sharp fragment, or simply the anterior buttress or body of the vertebrae may be crushed upon itself, without any serious or permanent

¹ Sir Astley Cooper, Fractures and Dislocations of Joints; Malgaigne, Fractures and Dislocations; A. Shaw-Holmes, System of Surgery; Gurlt, Handbuch der Lehre von dem Knochenbrüchen, Hamm. 1864; Sir Charles Bell, Observations on Injuries of the Spine and of the Thigh Bone, 1824; Hamilton on Fractures and Dislocations; Bryant, Practice of Surgery.

injury to the cord having occurred. This is illustrated in Plate X.

The higher the injury of the bony column, the greater fatality. Gurlt² reports that out of 178 cases where the cervical vertebrae were fractured, death occurred in 164, or 90 $\frac{1}{2}\%$. Out of 184 in the dorsal region, death occurred in 146, or 79 $\frac{2}{3}\%$. Out of 82 in the lumbar region, death occurred in 56, or 68 $\frac{1}{3}\%$. This ratio of mortality is quite what we should expect, as the nearer we approach the respiratory centre, the more fatal is the injury.³

By the courtesy of the Surgeons of the Boston City Hospital, I have been enabled to collect all the cases (82) that have occurred in that Hospital, and have tabulated them, to ascertain what facts they will show. The data thus obtained is represented in Tables D, E, F, G, and H, and the lines represented opposite present a synopsis of the detailed account that appears in the tables.

First, regarding the mortality of these cases, we find that the fatality is very great, and this is represented by Table A 1.

The fatality I have further analyzed to show mortality according to location. This is represented in Table A 2.

The striking immediate fatality of the accident is shown in Table A 3.

The recoveries have been divided into two classes :—the first, where the patient was useful, in the sense of being self-supporting ; the second, useless, where the patient is bed-ridden, and unable to earn a livelihood. So that we really have in these 82 cases of Fracture of the Spine, an apparent recovery of 22%, where really there is only 11% returned as producers in the community. This is shown in Table B.

The ratio of frequency of prominent symptoms occurring after fractures of the spine, is shown in Table C.

² Ibid. p. 72.

³ Bryant, ibid. p. 105.

The utter hopelessness which is expressed in the term broken back, pervades the minds of all practitioners, and

FREQUENCY OF SYMPTOMS.

Table C.

| TOTAL CASES. | |
|--------------|-----------------------|
| 82 | CREPITUS. |
| 51 | DEFORMITY. |
| 63 | UNCONSCIOUSNESS. |
| 18 | PARALYSIS COMPLETE. |
| 67 | PARALYSIS INCOMPLETE. |
| 6 | PAIN. |
| 71 | PRIAPIST. |
| 18 | DELIRIUM. |
| 12 | CYSTITIS. |
| 31 | BEDSORES |
| 27 | |

REGION.

Table A.2.

| TOTAL CASES. | |
|--------------|---------------|
| 82 | CERVICAL. |
| 28 | RECOVERIES. |
| 2 | UPPER DORSAL. |
| 12 | RECOVERIES. |
| 4 | LOWER DORSAL. |
| 19 | RECOVERIES. |
| 1 | LUMBAR. |
| 23 | RECOVERIES. |
| 10 | |

MORTALITY.

Table A.1.

| TOTAL CASES. | |
|--------------|-------------|
| 82 | DEATHS. |
| 64 | RECOVERIES. |
| 18 | |

TIME.

Table A.3.

| TOTAL DEATHS. | |
|---------------|-----------------|
| 64 | WITHIN 5 DAYS. |
| 39 | WITHIN 10 DAYS. |
| 8 | WITHIN 1 MO. |
| 7 | AFTER 1 MO. |
| 10 | |

RESULTS.

Table B.

| TOTAL RECOVERIES | |
|------------------|---------|
| 18 | USEFUL. |
| 9 | USELESS |
| 9 | |

perhaps Erichsen⁴ expresses the general feeling, when he says that "Fractures of the Spine through the bodies of the vertebrae with displacement, are inevitably fatal."

⁴ System of Surgery.

The treatment of fractures of the spine may be divided into three principal heads :—

- a.* Expectant. Water bed. Air bed. Wire bed. Bonnet's vertebral gutter. Extension and counter-extension.
- b.* Operative. Trephining. Removal of bony fragments.
- c.* Rectification of the deformity and fixation of the spine by plaster of Paris jacket or other apparatus.

a. EXPECTANT.—The statements made by Cline⁵ and by Cooper⁶ that we can accurately determine whether the body, or the arch, or the spine of a vertebra is broken, is not supported by facts. Further, Cline and Cooper believed that death was inevitable, sooner or later, if the fragment were not lifted by an operation.

This is possibly true, but specimens like Plate I. and Plate II. show only too clearly that, at times, we have to do with an irremediable injury, and our duty in such cases is to pursue the expectant plan of treatment—that is, placing the patient on an air or water bed, and treating the symptoms as they arise. By this means we can prolong life, and make existence bearable. It is possible that a certain amount of relief may be obtained in these severest cases by permanent extension and counter-extension.

Having decided that the expectant plan of treatment must be pursued in certain rare cases, we come to our second division, that of

b. OPERATIVE.—What further can I say to you than has been said in that bitter controversy between Sir Charles Bell⁷ and Sir Astley Cooper, as to the expediency of operations on the spine. Only on the parts posterior to the spinal cord, could an operation for a moment be entertained ; for to

⁵ Chelius Surgery, Vol. 1, p. 590.

⁶ Sir Astley Cooper on Disl. and Fract., 1851, p. 479.

⁷ Observ. on Injury of the Spine and of the Thigh Bone.

attempt to remove the body of a vertebra after fracture of the spine from behind, would necessitate the division of the spinal cord; to attack it in front would be equally inad-

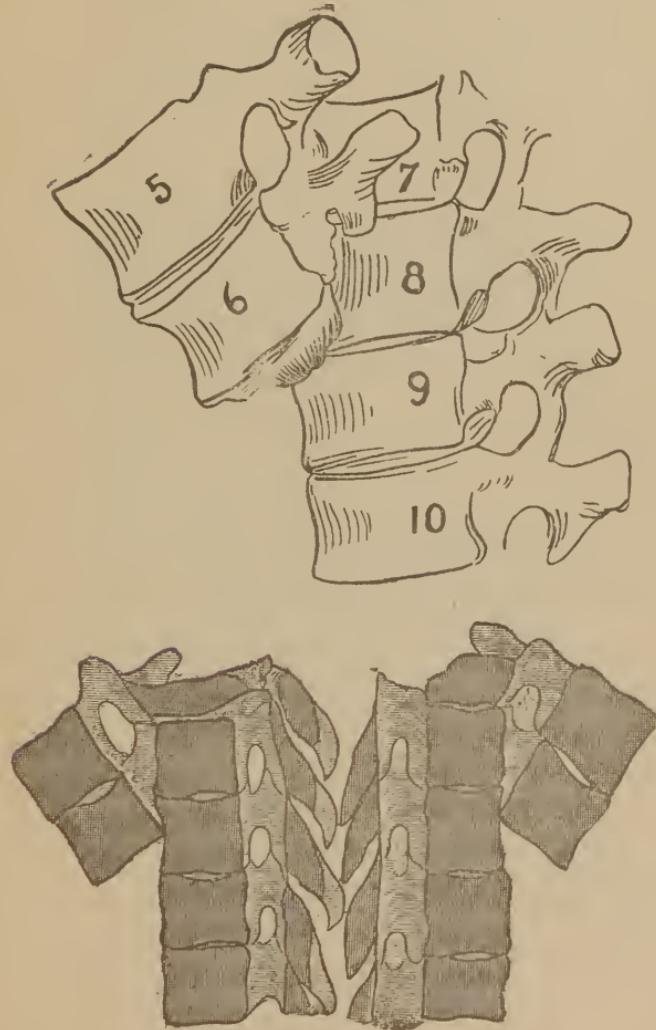


PLATE I.

(No. 1229 WARREN MUSEUM.)

The patient fell 30 feet. Wild and irritable, complete paralysis, bed sores, cystitis and death from exhaustion in two months. There has been a complete rupture of the intervertebral substance between the 6th and 7th vertebrae, the upper edge of the 7th being carried away to the right side with the 5th and 6th vertebrae. The state of the spinal cord in this case may be imagined.

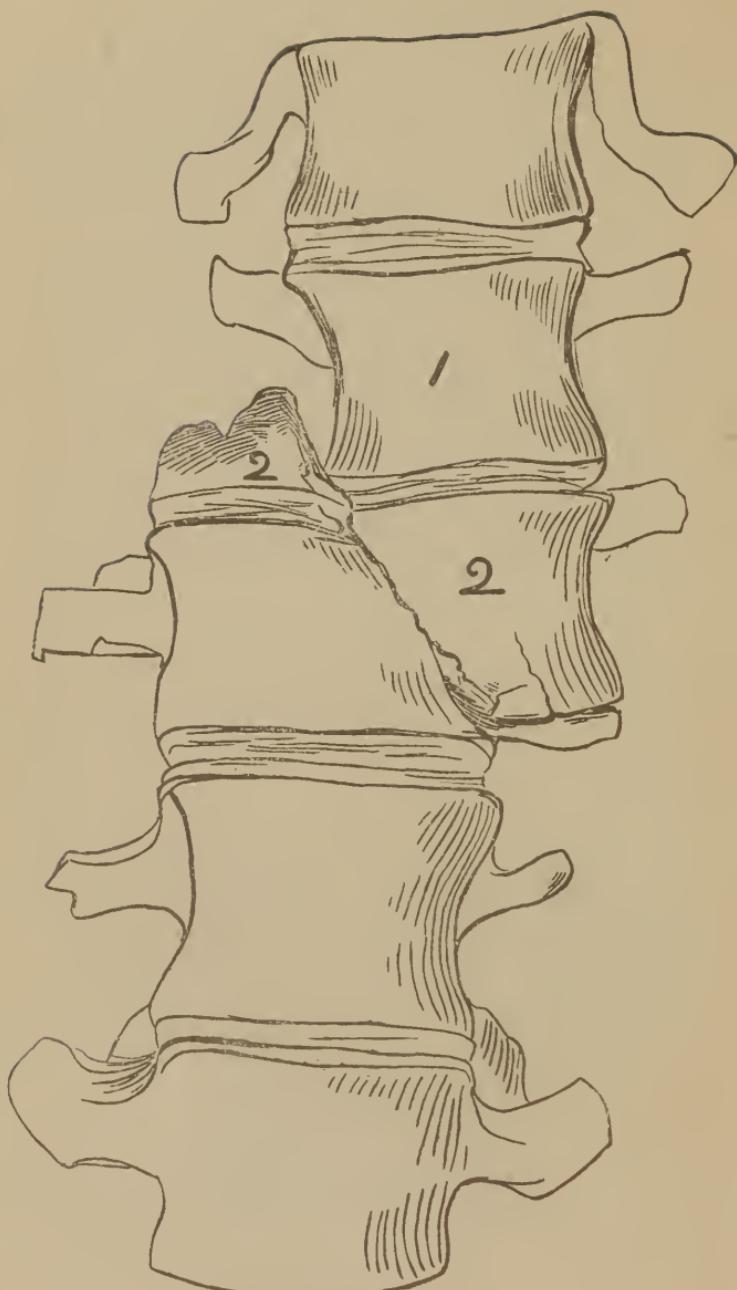


PLATE II.

(NO. 139 WARREN MUSEUM.)

T., æt. 19, run over by a fire engine. Complete parapysis, bed sores, cystitis, and died of exhaustion. There is a very extensive fracture and displacement of the 1st and 2d lumbar vertebræ. Cord completely destroyed.

(Table D.) TABLE OF OPERATIONS.

| NUMBER. | NAME. DATE. REFERENCE. | AGE. | SEX. | SURGEON. | CHARACTER OF ACCIDENT. | SEAT OF INJURY. | CREPITUS. | DEFORMITY. | UNCONSCIOUS- NESS. | PARALYSIS. | PAIN. | PRIAPIISM. | DELIRIUM. | CYSTITIS. | BED SORES. | DEATH. | AUTOPSY. | REMARKS. |
|---------|--|------|------|----------|--|---|-----------|------------|-----------------------|--|-------|------------|-----------|-----------|------------|-----------------------------------|----------|---|
| 21 | J. G. Jan. 14, 1867, vol. 9, p. 200. | 40 | M | Cheever. | Fell 25 feet, striking back. | 5 & 6 dorsal. | yes | yes | | Complete. | yes | yes | no | no | no | yes, next day. | no | An incision six in. long through muscles to spine. The spinous processes of 2, 3, 4, 5, d. vert. were found broken off, and were easily removed. Portions of laminae of 3 and 4 removed with trephine and "rongeur" forceps. All spiculae and sharp points removed. Cord exposed from 2 to 5 d. vert.; opposite the 3d, slight laceration of cord. Emphysema was now first noticed on r. side, and soon covered it. Pulse and respiration better than at beginning of operation. Pupils contracted; surface warm; cold compress on wound. Conscious that night; took nourishment well. Paralysis continued. Urine did not flow until pressure was applied: priapism nearly gone. Comfortable until noon of next day, when dyspnoea became marked. Became unconscious; died at 2 P.M. |
| 22 | J. G. Aug. 6, 1867, vol. 14, p. 156. | 33 | M | Homans. | Fell few hours before entrance | Tenderness, 7th cervical, 1st dorsal. | no | no | no | Complete below nipple. | yes | no | no | no | no | yes, 48 hrs. | no | An incision over 1 and 2 d., and 7 cerv. vert. was made. Some abnormal mobility was found, but no crepitus. |
| 23 | R. S. Dec. 14, 1867, vol. 13, p. 186. | 36 | M | Cheever. | Standing in a cart, horse started, patient thrown, striking on back. | 6th cervical, dislocation. | no | yes | no | Complete of legs; partial of upper extremities. | yes | no | no | no | no | yes, with- in 24 hrs. | yes | 9 P.M. same day, Dr. C. saw patient, and found cavity at nape of neck. Just above 7 cervical, spinous processes of 4, 5, 6 cerv. vert. could not be felt. Patient could rotate head, but pain over 7 cerv. vert. Decided to wait until morning. On A.M. following, Dr. C. made incision 3 in. long, extending from 7 cervical upward, without ether. 6 cerv. vert. found dislocated forward; no force could bring it into place. Spinous process and r. lamina and part of left lamina of 6th vert. and part of lamina of 5th removed by trephine; cord laid bare for 1 in. in length and nearly its whole breadth; membrane not ruptured. During operation, slight pressure was accidentally made on the cord; immediately patient would show signs of severe pain; pulse was slowed, and became intermittent; the moment pressure was removed, the pulse returned to its former condition. Application of cold produced the same effect. Little blood lost, and strength good; brandy twice. From this he failed rapidly; temp. 110° in axilla at 5 P.M.; and died 6 P.M. Autopsy.—The 6 cerv. vert. was dislocated forward, its articular processes being in front of those of the 7th. No fracture of bone, or laceration of ligaments; an abrupt depression in spinal canal at point of dislocation. Post. lig. stretched tightly over upper margin of 7 cerv. vert. Cord and membranes normal to the eye. |
| 70 | J. C. Aug. 20, 1884, vol. 121, p. 175. | 28 | M | Gay. | Fell 3 stories. | 4th dorsal. | yes | yes | yes, at first. | Complete below 5th rib. | yes | no | | | | 4th day. | no | An incision was made over spines of upper dorsal vert. Spinous process of 4th was found to be broken off, its body tilted and dislocated inwards, the articular processes of the vertebra visible. Extension, movements of neck and body, and traction by forceps, all failed to accomplish replacement. |
| 71 | S. G. Dec. 28, 1884, vol. 126, p. 72. | 53 | M | Gay. | Attempted to get out of bed quickly; feet caught in sheet; fell, striking on neck and shoulders. | 5th cervical. | yes | yes | no | Complete. | yes | | | | | In 36 hrs. | no | Dr. Gay cut down on to the deformity, but failed to reduce it. |

(Table E.) TABLE OF AUTOPSIES.

| NUMBER. | NAME. DATE. REFERENCE. | AGE. | SEX. | SURGEON. | CHARACTER OF ACCIDENT. | SEAT OF INJURY. | CREPITUS. | DEFORMITY. | UNCONSCIOUS- NESS. | PARALYSIS. | PAIN. | PRAPIASM. | DELIRIUM. | CYSTITIS. | BED SORES. | DEATH. | AUTOPSY. | REMARKS. |
|---------|---|------|------|------------|--|---|-----------|------------|-----------------------|---------------------------|-------|---------------------|---------------------------|-----------|-------------------|-------------|--|--|
| 23 | | | | | | | | | | | | | | | | | | |
| 28 | J. W. Aug. 29, 1870, vol. 30, p. 138. | 22 | M | Thorndike. | Fell from staging on back. | Tenderness, 7th cervical. | no | no | no | Complete. | yes | yes | | | | 4 days | | (See Table of Operations.) |
| 33 | P. C. Aug. 31, 1872, vol. 43, p. 118. | 30 | M | Gay. | Fell 5 days before entrance, striking on back of neck. | Cervical dislocation. | no | no | no | Complete below nipples | yes | | yes | | | 7 days | yes | Autopsy showed 5th and 6th cerv. vert. dislocated; softening of cord corresponding to seat of injury. |
| 35 | C. M. March 23, 1873, vol. 45, p. 230. | 45 | M | Thorndike. | | 4th & 5th cervical. | yes | yes | no | Complete below nipples | yes | yes | | | | next day | yes | Attempts were made in this case to reduce the deformity, without avail. Autopsy—Examinations of organs not remarkable; 3, 4, & 5 cerv. vert. fractured; cord pressed upon and softened. On pressure upon these vertebrae, post mortem, the deformity could be reduced, and pressure of cord relieved. |
| 43 | J. B. Sept. 10, 1875, vol. 61, p. 3. | 67 | M | Gay. | Fell quite a dis- tance; did not enter hospital for 6 days. | 5th cervical. | no | slight | | Complete. | yes | no | yes | yes | yes | 8 days | yes | Autopsy.—Granular kidney; cystitis; left pleuritis with effusion; slight lepto-meningitis. There was a fracture of r. transverse process, and part of the body of the 5th cerv. vert., with injury of the inter-vertebral substance. |
| 51 | C. E. Sept. 6, 1879, vol. 84, p. 240. | 39 | M | Fifield. | Struck on head, and knocked to ground. | Dislocation of ulnas. | no | yes | yes | Complete. | yes | | | | | 28 hours | yes | Extreme perspiration and cyanosis. Autopsy.—Dislocation of atlas, with rupture of lateral ligaments. |
| 54 | W. P. Sept. 26, 1880, vol. 92, p. 24. | 52 | M | Fifield. | Struck by a railroad train. | Multiple inju- ries; fracture of 2 or 3 vert. in dorso-lum- bar region. | yes | yes | no | No. | yes | no | no | | | 2d day | yes | Autopsy.—There was a fracture of 2 or 3 ribs near the dorso-lumbar region. The spine itself was broken transversely through the body of the first lumbar vert., and a segment of the last dorsal vert. was broken off. |
| 57 | W. W. Aug. 12, 1881, vol. 98, p. 87. | 45 | M | Fifield. | While drunk, fell 15 feet. | 7th dorsal. | yes | yes | no | Complete. | yes | | yes | yes | in 119 days | yes | Next day after entrance, sense of constriction about waist. Autopsy.—Pleuritis with effusion; emphysema of lungs; cystitis; pyleitis; fatty liver; fracture of anterior part of 7th dorsal, with compression, and complete disintegration of cord. | |
| 62 | S. D. June 3, 1882, vol. 103, p. 164. | 83 | M | Ingalls. | Fell 18 feet. | 4th cervical. | yes | yes | semi | Complete. | yes | no | no | no | | next day | yes | Autopsy.—Fracture of body of 4th with dislocation forward; fracture of transverse processes of the 3d and 4th cerv. vert. Complete disorganization of the cord. |
| 59 | H. B. W. March 22, 1882, vol. 101, p. 94. | 68 | M | Ingalls. | Fell 15 feet, striking on back. | 7th to 12th dorsal. | yes | yes | no | Complete. | yes | no | no | no | in 12 hours | yes | Apparent depression at 7th and 9th dorsal, and dislocation, with prominence of the 11th and 12th dorsal, with deflection to the left. Extension to legs; counter-extension by raising foot of the bed. Autopsy.—Fracture of the 12th dorsal, with part of the body of 11th; compression of the cord; fractured rib; pyelo-nephritis. | |
| 63 | T. T. June 20, 1882, vol. 103, p. 254. | 27 | M | Ingalls. | Fell 15 feet. | 6th cervical. | no | no | | Complete. | yes | yes | yes | yes | in 60 days | yes | Tympanitis. Autopsy.—Fracture of the body (transverse) and articular processes of the 6th cerv. vert.; amyloid degeneration of spleen, liver and kidneys. | |
| 73 | M. C. May 27, 1885, vol. 128, p. 176. | 44 | F | Homans. | Fell down stairs. | 8th dorsal. | no | no | no | Complete. | yes | yes | yes | yes | in 3 mos. | yes | Autopsy.—Fracture of 8th dorsal, with crushing and displacement backwards; traumatic myelitis at seat of fracture. Spinal cord at seat of injury reduced to $\frac{1}{2}$ the size, and on section it was found to consist of a tube, the wall formed by pia, with a small amount of nervous substance adherent, and a cavity the size of a lead pencil, filled with a thin puriform fluid. The cord, for about 1 cm. above and below the above site, was softened, yellow and opaque, there being no distinction between the gray and white portions. At this point, the 8th dorsal was pressed backward so as to reduce the spinal canal one half. | |
| 80 | G. F. Nov. 24, 1886, vol. 181, p. 125. | 74 | M | Cheever. | Fell 30 feet. | 12th dorsal. | yes | yes | semi | Complete. | | | | | in 18 hours | yes | Autopsy.—Fracture vertebra; red softening of cord; hemorrhage into pia, plural cavities, lung and mediastinum. | |
| 78 | H. S. Aug. 10, 1886, vol. 138, p. 136. | 45 | F | Burrell. | Fell 10 feet. | 12th dorsal. | yes | yes | drunk | Incomplete. | yes | delirium tremens | yes 1-1/2% albumen. | | in 2 days | yes | Autopsy.—Twelfth dorsal vert. was fractured in upper portion, giving rise to an arching backward of spine, and a projection backward of a plate of bone, which in turn had pressed on the cord. This pressure had led to red and white softening for a distance of about 15 mm. Above this was an extravasation between the dura and periosteum. | |

(Table F.)

CASES TREATED BY IMMEDIATE CORRECTION OF DEFORMITY, AND FIXATION BY PLASTER OF PARIS JACKET.

| NUMBER. | NAME. DATE. REFERENCE. | AGE. | SEX. | SURGEON. | CHARACTER OF ACCIDENT. | SEAT OF INJURY. | CREPITUS. | DEFORMITY. | UNCONSCIOUS- NESS. | PARALYSIS. | PAIN. | PRIAPIST. | DELIRIUM. | CYSTITIS. | BED SORES. | DEATH. | AUTOPSY. | REMARKS. | | |
|---------|--|------|------|---|--------------------------------|---|-----------|--|-----------------------|------------|-------------------------|-----------|-----------|-----------|------------|-------------|----------|--|---|--|
| | | | | | | | | | | | | | | | | | | REMARKS. | | |
| 66 | W. B. April 6, 1884, vol. 119, p. 57. | 58 | M | Ingalls. | Fell down stairs 20 feet. | Middle dorsal. | yes | yes | no | Complete. | yes | yes | yes | yes | no | 11 days. | no | On entrance a plaster of Paris jacket was applied, the patient being suspended by a tripod; deformity reduced by this means; immediate relief from pain; jacket comfortable all the time; could move in bed without pain. Delirium. Death on 11th day, refusing nourishment and stimulants. | | |
| 14 | P. R. July 15, 1884, vol. 121, p. 86. | 37 | M | Bolles. | Fall. | Neigh- bor- hood of last dorsal. | no | yes | | Complete. | | | | yes | yes | | | | Splint of plaster of Paris at once applied. Discharged Oct. 17, 1884, relieved. Sept. 23, 1886, letter: Paraplegia; can feel a few inches down from trunk. Legs are crooked and draw up spasmodically. Constipation. Uses catheter. Sits up 4 to 5 hours daily. No medical advice for a year. Now in New Brunswick. | |
| 17 | F. O. Aug. 24, 1886, vol. 138, p. 181. | 21 | M | Burrell. | Fall 40 feet. | Lower dorsal 12th. | yes | Gen. curve, with knuckle at 12d. angle 30° | yes at first. | Complete. | yes | | | | | | | | Pat. suspended; deformity reduced as much as possible by pressure; "crunching" of vertebrae felt on reduction; p. of P. jacket applied; sensation in limbs returned immediately. Deformity reduced 11 hours after accident; retention and constipation ceased on 3d day. Spt. 21, patella reflex somewhat exaggerated; no ankle clonus; urine normal. Can move left slightly; r. leg considerably. Oct. 27, '86, has continued to improve in moving legs; can turn in bed; sensation perfect. Nov. 17, '86, p. of P. removed; no patella reflex; no ankle clonus; movement of l. leg good; moves r. toes; cannot lift r. leg; some pain in r. thigh when lifted; strychnia sulph. gr. 1-60, 3rd; sits up in steamer chair. Jan. 21, 1887, pat. walking about with aid of chair; power of r. leg slowly improving. Mar. 10, 1887, walks unaided. Apr. 23, '87, walked out in yard; electricity thrice weekly. May 1, '87, examined by Dr. P. C. Knapp; l. thigh and leg, no galvanic reaction; all muscles react to faradic current; r. thigh and leg, no faradic reaction; walks with halts in r. leg. May 4, '87, went home, 129 Chelsea St., Charlestown, Mass. May 5, '87, bar-tender. | |
| 81 | J. J. Sept. 21, 1886, vol. 139, p. 67. | 38 | M | Gavin. | Fall 12 feet. | 7th cervical. | no | no | no | Complete. | yes | yes | yes | yes | yes | 2 mos. | no | Pat. weighed over 200 lbs.; suspended; great pain and dyspnoea; had to be let down; p. of P. applied while suspended; jacket required to be cut up on 2d day, owing to difficulty in breathing; griping nearly 1 hr.; no improvement from jacket; removed on 6th day; abdominal breathing. 3d day, "girdle" sensation. 8th day, paralysis of arms; slough of ear from pressure. 7th day, incontinence of urine and faeces. At end of one month, dribbling of urine. Bed sores, marked emaciation, delirium, death. | | |
| 18 | T. S. Nov. 26, 1886, vol. 140, p. 244. | 23 | M | Burrell, by courtesy of Dr. M. F. Gavin. | Fall into a sewer, 30 feet. | General curve 7th dorsal to 1st lumbar. | yes | yes | 20 minutes. | None. | yes, very severe. | | | | | | | | Treated by immediate correction of deformity and fixation by p. of P. jacket. Dec. 5th, plaster splint 2 strap applied. Dec. 8th, jacket removed owing to defective padding; knuckle found at 10th dorsal; jacket reapplied; no paralysis. Dec. 9, discharged, own request, against advice, wearing jacket. Feb. 14, '87, walked into Boston City Hosp. for re-application of jacket; no paralysis or pain; slight deformity at 10 to 12 dorsal vert. | |

CASE UNDER TREATMENT JUNE 7, 1887.

| | | | | | | | | | | | | | | | |
|--|---|------|---------------------------------|--------------|-----|--------------|-----|-----------|-----|-------|----|-----|-----|--------------------|--|
| C. M. May 17, 1887, vol. 147, p. 76. | M | Gay. | Struck by a falling derrick. | 10th dorsal. | yes | angle 45° | yes | Complete. | yes | semi. | no | yes | yes | under treatment | Within a few hours of the accident; pat. was etherized; deformity was partially reduced, and a p. of P. jacket with shoulder straps was quickly applied. Jacket was uncomfortably tight; 3d day split up over abdomen; 4th day completely, owing to tympanites. Moved toes 2d day, slightly right foot. Has had and has now hyperesthesia of the legs; this is diminishing. Moved right leg voluntarily the 13th day; left leg as bad as ever. Bed sore over sacrum, also over calf of r. leg. Turns on either side; the jacket very comfortable; cystitis better. |
|--|---|------|---------------------------------|--------------|-----|--------------|-----|-----------|-----|-------|----|-----|-----|--------------------|--|

missible, for the thoracic viscera, aorta, solar plexus, and vena cava would forbid; and an attempted removal from the side would be equally inexpedient.

Five cases have been operated upon at the Boston City Hospital, and they appear in Table D of Operations. All ended fatally.

It may be of interest to see the status that this procedure should occupy in Surgery. Paré, Heister, and many of the older authors discussed the propriety of excising portions of the vertebrae or trephining, but Henry Cline⁸ first performed the operation at St. Thomas's Hospital, June 16th, 1814. The patient lived seventeen days, and Mr. Cline admitted that the operation hastened the end. Lidell⁹ failed to find a single well authenticated successful case. It is certainly true, that Legoust,¹⁰ Jobert,¹¹ E. Gurlt,¹² Hamilton¹³ and Sir Charles Bell¹⁴ all condemn the operation in unqualified terms.

Gun-shot injuries, however, may be excepted from this sweeping condemnation, and all the reported successful cases of operation, closely resemble that done by Louis¹⁵ in 1762, where bony fragments were removed after a gun-shot fracture of the spine.

The removal of fragments after gun-shot injuries to the spine is perfectly justifiable, and will, I believe, give a fair measure of success. In the War of the Rebellion¹⁶ "there were twenty-four cases of removal of fragments of the vertebrae after gun-shot fracture, with fatal results in only

⁸ New England Journal of Medicine and Surgery, Vol. IV., No. 1, January, 1815.

⁹ On injuries to the Spine, American Journal Medical Sciences, October, 1864; Vol. XLVIII. p. 320.

¹⁰ Chirurgie d'Armee, pp. 341, 352.

¹¹ Plaies d'Arnee a feu, Paris, 1833, p. 125.

¹² Handbuch der Lehre von dem Knochenbrüchchen Hamm. 1864, p. 186.

¹³ Treatise on Fractures and Dislocations, p. 187.

¹⁴ Observations on Injuries of the Spine and of the Thigh Bone, 1824.

¹⁵ Remarques et Observations sur les Fractures et la Luxation des Vertebrae, Mem. Path. Arch. Gen. de Med., 1836, LXI. 2 Série, p. 417.

¹⁶ Hist. of the War of the Rebellion, Pt. I, Surg. Vol., p. 459.

ten instances." In nine instances, however, of the fourteen examples of recovery, the spinous process, or fragments of it, only were removed. In the five cases of recovery, in which portions of the lamina or the transverse processes were removed, the results were much less satisfactory, nearly all of the patients having serious disability.

On the other hand, the operating on fractures of the spine, not compound, is not a justifiable measure, and without further evidence supporting this operation, it will have to be placed among the impracticable efforts of experimental or venturesome surgery.

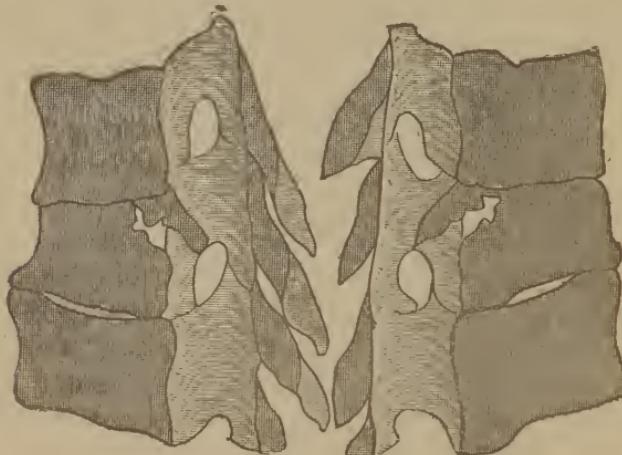


PLATE III.

c. IMMEDIATE RECTIFICATION OF THE DEFORMITY IN FRACTURE OF THE SPINE AND FIXATION BY PLASTER OF PARIS JACKET.—On the 10th of August, 1886, I saw the autopsy of a woman who had been under my care, with a fracture of the spine, in the Boston City Hospital (Plate III. Case 78), and found that a plate of bone from the posterior wall of the body of the 12th dorsal vertebra had been broken off, in addition to an arching backward of the whole spine. This plate had pressed upon the cord, and had, in 38 hours,

led to red and white softening for a distance of 15 mm. The presence of the plate *anterior* to the cord showed me that an operative procedure would have been of no avail, and the *softening* occurring so early in the cord, led me to believe that, if aught was to be done to remedy the damage caused by a fracture of the spine, it must be at once.¹⁷

The arching of the vertebrae suggested that the difficulty might be overcome by *immediately* pressing back the deformity, and fixing it in this corrected position.

I determined to act upon this principle in the next case. On Aug. 24th, 1886, Case 17 was admitted, and was seen within twelve hours of the time of his fall of 40 feet. The risks of immediate reeification and suspension having been explained to him, he was suspended, as represented in Plate IV., with this difference, that the tripod was placed over the head of the bed, a ward-master was placed upon a small table at either side of the patient to lift up on the body at the axillæ. This, when one has many assistants, is a great aid to the patient. The back of the patient, while being changed from the horizontal to the perpendicular position, should be carefully supported, and when the patient is brought into an erect position the buttocks are free from the table.

The deformity, which was at an angle of at least 30° and included the 12th dorsal vertebra, was reduced, and a plaster of Paris jaeket was quickly applied. An anæsthetic was not given, for I did not wish to have any danger masked. The patient's sufferings during the suspension, reeification and application of the jaeket, were more intense than anything I have ever seen; he nearly collapsed, but the jacket was finished, and stimulants were given. On recovering himself, he said that there had been an immediate return of sensation in his limbs, directly following the reduction of

¹⁷ Case 80. Red softening in cord. Death in 18 hours. Table of Autopsies, E.

the deformity. His recovery proceeded uninterruptedly. On April 23d, 1887, for the first time he walked out. Dr. P. C. Knapp examined him on May 1st, 1887, and found

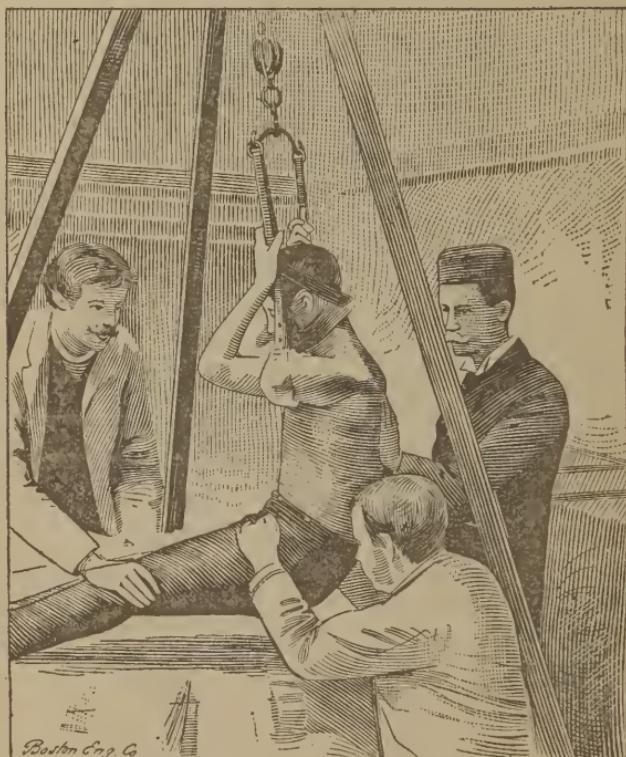


PLATE IV.

in the left thigh and leg no galvanic reaction. All muscles react to faradic current. The right thigh and leg have no faradic reaction. He now walks with a halt in the right leg, and on May 5th, 1887, was found acting as a bar tender. Plates V. and VI. represent his present condition.

This procedure at the time I supposed to be an original thought, but soon found that other gentlemen in the same hospital had preceded me.

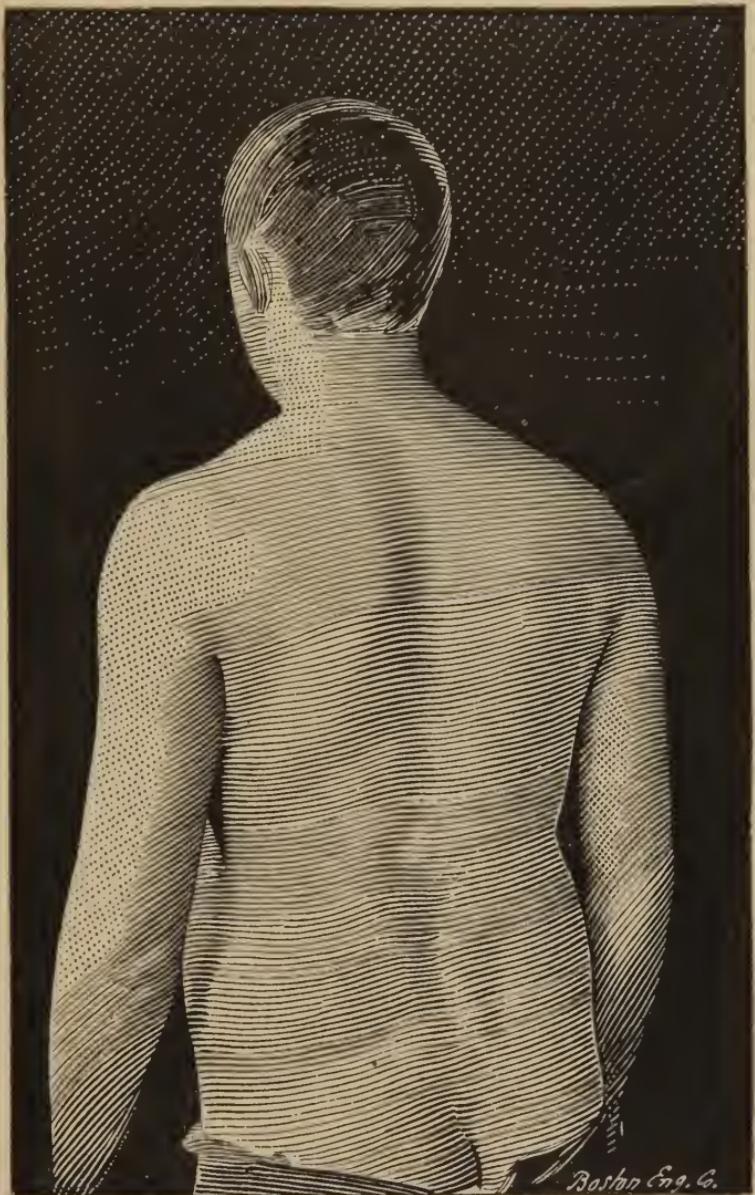


PLATE V.



PLATE VI.

Five cases has been treated in this manner in the hospital to a completion. Dr. Wm. Ingalls (Case 66, Table F) on April 6th, 1884, applied a jaeket to a fractured spine, the deformity having rectified itself by suspension, but his patient unfortunately died. Dr. W. P. Bolles (Case 14, Table F) on July 15th, 1884, applied a splint of plaster of Paris at once to a fractured spine, and his patient recovered, but is useless. Dr. M. F. Gavin (Case 81, Table F) on Sept. 21st, 1886, rectified the deformity in a fraetured spine, having suspended a patient weighing over 200 lbs. Great dyspnoea and pain occurred. The jacket did absolutely no good, requiring to be cut up on the second day, and gaped nearly an inch. The patient died in two months, of exhaustion.

On Nov. 26th, 1886 (Case 18, Table F), by the courtesy of Dr. Gavin I was again enabled to attempt the rectification of a fracture of the 10th dorsal vertebra, and applied a plaster of Paris jacket; this case was seen a short time after the fracture occurred. There was no paralysis, and the patient made a good recovery.

Of these five cases two have died, one is useless, and two have recovered. (See Table F.)

Of the expediency of rectification of the deformity, I can but think that an important lesson can be learned from a study of these drawings of specimens from the Warren Anat. Museum. Plates I. and II. show that any efforts would be futile; while Plates IX., X., XI., XII. and XIII. are very suggestive as to the possibility of immediately rectifying the deformity.

The application of the plaster of Paris jackets for fracture of the spine is by no means a new idea, and the literature on the subject at my command gives me the following facts :

In the fall of 1874 Professor Sayre states that he first applied a plaster of Paris jacket for Pott's disease; and

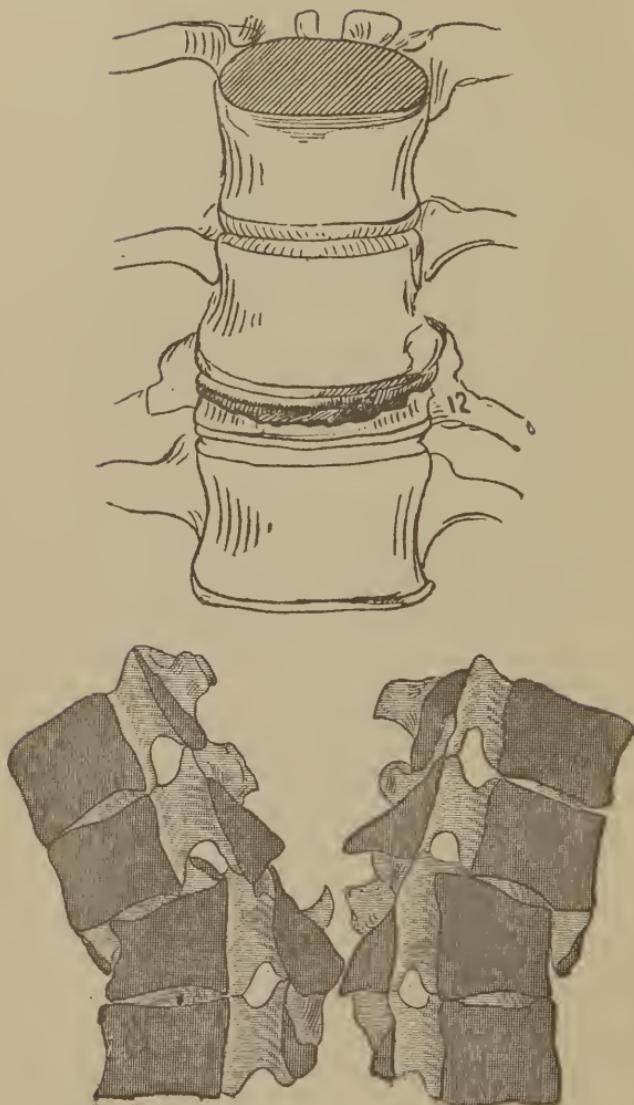


PLATE IX.

(No. 140 WARREN MUSEUM.)

Fracture of 12th dorsal, with displacement; extensive laceration of inter-vertebral substance; cord almost completely severed; death, 9½ weeks; paralysis, bed sores, cystitis.

(Table G.) TABLE OF DEATHS.

| NUMBER. | NAME. DATE. REFERENCE. | AGE. | SEX. | SURGEON. | CHARACTER. OF ACCIDENT. | SEAT OF INJURY. | CREPITUS. | DEFORMITY. | UNCONSCIOUS- NESS. | PARALYSIS. | PAIN. | DELIRIUM. | CYSTITIS. | BED SORES. | DEATHS. | AUTOPSY. | PRIAPISM. | REMARKS. |
|---------|--|------|------|-------------|--|---|-----------|------------|-----------------------|----------------|-------|-----------|-----------|---------------------------|-----------------------|----------|---|--|
| 19 | J. S. March 21, 1866, vol. 7, p. 8. | 28 | M | Buckingham. | Fall. | Upper lumbar. | yes | | | Complete. | yes | no | yes | yes | Yes Jan. 10, 1867. | no | no | Treatment—rest in bed; electricity; strychnia, sulph. gr. 1-60 3id. Discharged well, Dec, 4, 1866. Letter from brother May 15, 1887, states that patient died Jan. 10, 1867, from exhaustion, bed sores and inflammation of bladder. |
| 20 | M. B. June 15, 1866, vol. 10, p. 57. | 21 | M | Cheever. | | Cervical. | yes | yes | yes | Complete. | yes | no | no | no | June 16, 1866. | no | no | |
| 21 | | | | | | | | | | | | | | | | | | (See Table of Operations.) |
| 22 | | | | | | | | | | | | | | | | | | " " " " |
| 23 | | | | | | | | | | | | | | | | | | (See Table of Operations and Autopsies.) |
| 24 | C. C. Oct. 16, 1868, vol. 19, p. 220. | 37 | M | Thaxter. | Blow on head from falling bale of cotton. | Dislocation of atlas, forward and fracture. | no | yes | no | Complete. | yes | | | | 4th day. | no | no | Respiration abdominal; all efforts at reduction futile; death from suffocation. |
| 25 | T. C. July 20, 1869, vol. 20, p. 14. | 52 | M | Ropes. | Pack of leather (150 lbs.) fell on back while stoop- ing. | Cervical. | | | | Complete. | yes | | | | 36 hours. | no | no | |
| 26 | W. N. Jan. 30, 1870, vol. 25, p. 241. | 33 | M | Cheever. | Fell 3 stories, striking on back. | Cervical. | no | yes | no | Complete. | yes | | | | Next day. | no | yes | |
| 27 | J. M. April 19, 1870, vol. 28, p. 114. | 24 | M | Thorndike. | Fell from scaffold. | Injury to head, fracture 8th dorsal. | yes | yes | no | Complete. | yes | no | no | no | 4 days. | no | no | Much deformity at 8th dorsal; abdominal breathing. |
| 28 | | | | | | | | | | | | | | | | | | (See Table of Autopsies.) |
| 29 | J. D. Nov. 6, 1870, vol. 33, p. 1. | 23 | M | Thaxter. | Fell 50 feet 9 days before entrance. | Lower lumbar. | no | no | yes | Partial. | yes | yes | yes | 18th day after injury. | no | | | |
| 30 | M. F. Jan. 11, 1872, vol. 46, p. 216. | 27 | M | Thorndike. | Fell 10 feet strik- ing on back. | 9th, 10th and 11th dorsal. | yes | yes | no | Complete. | yes | yes | yes | 25 days. | no | yes | Day after entrance etherized; deformity reduced by extension and counter-extension, and pressure over deformity; trunk secured to head of bed, and 15 lbs. of extension applied to legs. In 1 week, delirium tremens: incontinence of urine. Failed gradually; death from exhaustion. | |
| 31 | C. S. July 5, 1872, vol. 41, p. 209. | 33 | M | Ingalls. | Fell while intox- icated from 3d story window. | Multiple injuries; upper dorsal. | yes | no | | Complete. | yes | | | | In 1 week. | no | yes | |
| 32 | J. H. Aug. 3, 1872, vol. 43, p. 65. | 50 | M | Ingalls. | Fell 9 days before entrance. | 11th and 12th dorsal. | yes | yes | no | Complete. | yes | yes | yes | 1 month. | no | no | Exhaustion. | |
| 33 | | | | | | | | | | | | | | | | | | (See Table of Autopsies.) |
| 34 | P. S. Oct. 21, 1872, vol. 43, p. 264. | | M | Gay. | Intoxicated; wheel over neck. | 6th and 7th cervical. | no | no | no | None at first. | yes | | | | 2d day. | no | yes | On entrance, complained of pain in neck; physical exam. negative. In 3 hours legs became paralyzed; abdominal respiration; later, complete paralysis; great thirst; death. Distinct crepitus felt after death, between 6 & 7 cerv. vert. |
| 35 | | | | | | | | | | | | | | | | | | (See Table of Autopsies.) |
| 36 | O. B. July 16, 1873, vol. 47, p. 154. | 40 | M | Ingalls. | | 4th and 5th cervical. | yes | yes | no | Below 3d ribs. | yes | | | | Next day. | no | yes | |
| 37 | M. F. Oct. 20, 1873, vol. 52, p. 14. | 38 | F | | Fell from 2d story, admitted following day. | Dorsal. | | yes | | Complete. | | yes | yes | 3 months. | no | | | |

TABLE G (Continued).

| | | | | | | | | | | | | | | | | | | |
|----|--|----|---|------------|---|-------------------------------------|--------------------------|-----|-----------|----------------|-----|-----|-----|-----------|--|-----|-------------------------------------|---|
| 38 | M. M. June 12, 1874, vol. 56, p. 26. | 38 | M | Homans. | | Cervical. | yes | yes | no | Below 2d ribs. | yes | no | no | no | 24 hours. | no | yes | |
| 39 | J. T. Aug. 13, 1874, vol. 53, p. 113. | 50 | M | Gay. | Tossed by a bull. | 3d or 4th cervical. | yes | yes | no | Complete. | yes | | | | Same day. | no | | Respiration abdominal; thirst. |
| 40 | E. H. Sept. 2, 1874, vol. 53, p. 143. | | M | Gay. | Fell 30 feet. | Lumbar, fracture of pelvis. | yes | yes | | Absent. | yes | | | | Next day. | no | | Died suddenly, speaking 5 minutes before death. |
| 41 | E. T. May 3, 1875, vol. 57, p. 270. | 33 | M | Ingalls. | Fell 18 feet. | 7th or 8th dorsal. | yes | yes | no | Complete. | yes | yes | yes | yes | 52 days. | no | | Incontinence of urine and faeces. |
| 42 | J. W. Sept. 12, 1875, vol. 39, p. 271. | 34 | M | Gay. | Fell 8 feet. | Mid. dorsal. | yes | yes | | Complete. | yes | yes | yes | yes | In 1 month. | no | no | Exhaustion. |
| 43 | | | | | | | | | | | | | | | | | (See Table of Autopsies.) | |
| 44 | W. F. Nov. 10, 1875, vol. 64, p. 84. | 15 | M | Thorndike. | Wheel of cart passed over chest. | 4th and 5th dorsal. | yes | yes | yes | Complete. | yes | | | | 18 hours. | no | | Fract. 3 ribs on right side. |
| 45 | J. M. Sept. 24, 1873, vol. 52, p. 14. | | M | Fifield. | Fell 2 stories striking on back. | 2d and 3d lumbar. | yes | yes | yes | Complete. | no | | | | 4 hours. | no | | |
| 46 | B. M. Jan. 1, 1877, vol. 68, p. 227. | | M | Thorndike. | Struck by a falling basket of sand. | Multiple injuries 4th lumbar. | | yes | | | | | | | $\frac{1}{2}$ hour after admission. | | | |
| 47 | J. F. Oct. 30, 1877, vol. 74, p. 132. | 45 | M | Fifield. | Struck on head by chain of coal scuttle; fell some distance. | Lumbar; Multiple injuries. | | yes | no | Complete. | yes | | | | 4th day. | no | yes | Incontinence; splenous processes of lower lumbar vert. deflected to one side, and a space existed between 4 and 5 lumbar large enough to lay finger into tympanites; no dejection, even from ol. tigilli gtt. iv. |
| 48 | J. K. Aug. 25, 1878, vol. 42, p. 126. | 32 | M | Thorndike. | | 12th dorsal. | yes | yes | no | Complete. | yes | | | | Following day. | no | yes | |
| 49 | J. M. June 30, 1879, vol. 84, p. 77. | 23 | M | Homans. | Fell into a vessel's hold. | 7th dorsal. | yes | yes | no | Complete. | yes | no | yes | yes | 9 days. | no | yes | Tympanites; abdomen tapped with relief. |
| 50 | M. P. Aug. 13, 1879, vol. 83, p. 170. | 40 | M | Gay. | Fell down 10 steps. | | yes in lower cerv. | | Complete. | yes | no | no | no | Next day. | no | yes | Tympanites relieved by rectal tube. | |
| 51 | | | | | | | | | | | | | | | | | (See Table of Autopsies.) | |
| 52 | M. D. Oct. 10, 1879, vol. 86, p. 58. | 45 | F | Fifield. | Fell 3 stories. | Lumbar. | yes | yes | no | Complete. | yes | no | no | no | 6 days. | no | | Tympanites relieved by rectal tube. |
| 53 | J. H. May 22, 1880, vol. 87, p. 252. | 51 | M | Ingalls. | Fell 35 feet. | Lumbar. | | yes | | Complete. | | | | | Next day. | no | | Death sudden. |
| 54 | | | | | | | | | | | | | | | | | (See Table of Autopsies.) | |
| 55 | P. B. Oct. 14, 1880, vol. 91, p. 21. | 42 | M | Gay. | Fell 15 feet. | Upper lumbar. | yes | yes | no | Complete. | yes | no | no | no | 3d day. | no | no | Death said to be due to oedema of the lungs. |
| 56 | P. W. G. Feb. 10, 1881, vol. 91, p. 120. | 41 | M | Thorndike. | Elevator struck patient on back, "doubled him up." | 12th dorsal. | yes | yes | no | Complete. | yes | yes | yes | yes | 79 days. | no | | Etherized, and by extension, counter-extension and pressure over deformity, the deformity was nearly reduced; kept in position by pads; 10 lbs. extension and tight canvas belt; incontinence; 40 days after entrance, plaster of P. jacket applied; pat. grew steadily worse; death from exhaustion. |
| 57 | | | | | | | | | | | | | | | | | (See Table of Autopsies.) | |
| 58 | J. S. Aug. 22, 1881, vol. 98, p. 109. | 32 | M | Fifield. | Fell 30 feet. | Multiple injuries, 2d lumbar. | yes | yes | no | Complete. | yes | | | | 5 days. | no | | Cause of death obscure. |

TABLE G (Concluded).

| | | | | | | | | | | | | | | | |
|----|---|----|---|------------|--|---|-----|-----|-------------|-----------|-----|-----------|------------|--|--|
| 59 | E. W. May 6, 1882, vol. 104, p. 91. | 38 | M | Homans. | Fell 65 feet. | Multiple injuries, middle dorsal. | no | no | Complete. | yes | yes | 8 days. | no | (See Table of Autopsies.) Died suddenly, without cause being known. | |
| 60 | D. C. May 10, 1882, vol. 104, p. 106. | 39 | M | Homans | Fell 30 feet striking back. | 1st lumbar. | yes | | Complete. | yes | yes | 21 days. | no | Edema of penis; girdle sensation; tympanites. | |
| 61 | J. S. Aug. 8, 1882, vol. 108, p. 246. | 39 | M | Thorndike. | Struck on back by a boom. | 8th dorsal. | no | yes | semi | Complete. | yes | yes | 8 days. | no | (See Table of Autopsies.) " " " " |
| 62 | J. C. Aug. 10, 1883, vol. 114, p. 219. | 17 | M | Thorndike. | Fell 40 feet. | Multiple injuries, double frac- ture mid- dorsal. | yes | yes | yes | Complete. | yes | yes | 4 months. | no | Severe pain, with girdle sensation; vomiting. No special treatment; death from exhaustion. |
| 63 | J. C. May 22, 1884, vol. 122, p. 8. | 30 | M | Homans. | Struck by a boom. | 4th and 5th dorsal. | yes | yes | yes | Complete. | | | 24 hours. | no | (See Table for Immediate Rectification of Deformity and Fixation by P. of P. Jacket.) Concussion of brain; respiration diaphragmatic. |
| 64 | F. D. June 12, 1884, vol. 119, p. 269. | 25 | M | Post. | Railroad accident | Multiple injuries, fract. of mid. dorsal. | yes | yes | yes | Complete. | yes | | Few hours. | no | Pulseless at time of admission. |
| 65 | W. E. Aug. 2, 1884, vol. 121, p. 132. | 65 | M | Gay. | Fell down stairs. | 6th cervical. | no | yes | no | Complete. | yes | yes | 6 days. | no | Cyanosis; diaphragmatic respiration. |
| 66 | J. C. Jan. 5, 1885, vol. 126, p. 92. | 65 | M | Gay. | Fell from wagon, struck on face. | Cervical. | yes | | Complete. | yes | yes | 11 days. | no | (See Table of Operations.) " " " " | |
| 67 | C. S. Sept. 15, 1885, vol. 130, p. 234. | 25 | M | Bolles. | Fell from 2d story window. | Dorsal. | yes | | Complete. | yes | yes | Same day. | no | (See Table of Autopsies.) | |
| 68 | E. C. Jan. 6, 1886, vol. 132, p. 261. | 42 | M | Bolles. | Carriage fell on patient. | 4th cervical. | yes | yes | yes | Complete. | | | Next day. | no | Asphyxia. |
| 69 | E. C. Dec. 3, 1886, vol. 142, p. 12. | 45 | F | Bradford. | Fell 2 stories. | Cervical. | yes | no | at first | Absent. | | | 15 hours. | | Spoke five minutes before death. |
| 70 | M. C. July 31, 1886, vol. 138, p. 108. | 21 | M | Bolles. | Railroad injury, multiple. | 6th dorsal. | yes | yes | no | Complete. | yes | | 3 days. | no | No re-action from shock. |
| 71 | B. F. E. Oct. 20, 1886, Carney Hosp. | 50 | M | Burrell. | Fall from coal bridge 18 feet, striking on back. | 9th and 10th dorsal. | yes | yes | no | Complete. | yes | yes | 212 days. | no | (See Table of Autopsies.) Was transported from Lake Superior to Boston on an air bed: cystitis so severe that it perforated the recto-vesical septum, causing recto-vesical fistula. Complication of dribbling of urine from anus, relieved by glass rectal urinal. |
| 72 | A. M. April 11, 1887, vol. 143, p. 176. | 44 | M | Gay. | Fell 15 feet. | Lower cervical and upper dorsal. | no | no | no | Complete. | yes | no | 40 hours. | no | (See Table of Autopsies.) (See Table for Immediate Rectification of Deformity and Fixation by P. of P. Jacket.) Fracture bed; tympanites; diaphragmatic respiration. This may be a case of hemorrhage into or about the cord. |

doubtless to his bringing this method of treatment of Pott's disease¹⁸ before the profession is due the present application of plaster of Paris jackets in fresh fractures of the spine.

On June 25th, 1879, J. R. Weist, of Richmond, Indiana (see Appendix I.), reduced a fracture of the 9th

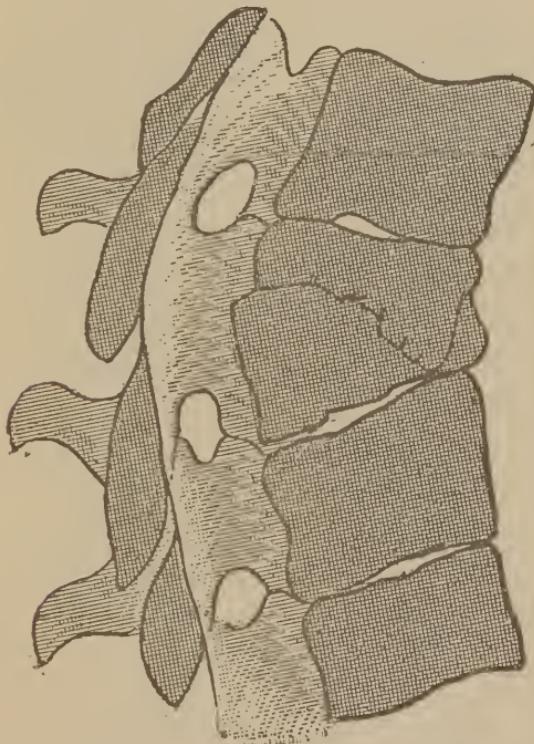


PLATE X.

(No. 1376 WARREN MUSEUM.)

Diagram of a fracture of the body of a vertebra, not narrowing the canal materially.

dorsal vertebra during suspension, and applied a plaster of Paris jacket. This was followed by a great relief to the pain, uninterrupted improvement, and a recovery of the patient on the 67th day.

¹⁸ Succinct History of the Plan of Treatment of Pott's Disease by Suspension and the use of Plaster of Paris Bandage, p. 4.

Dr. Weist says that when he applied the plaster dressing in this case, he was not aware that it had been used in such cases; but he learned from Dr. Sayre that it had been

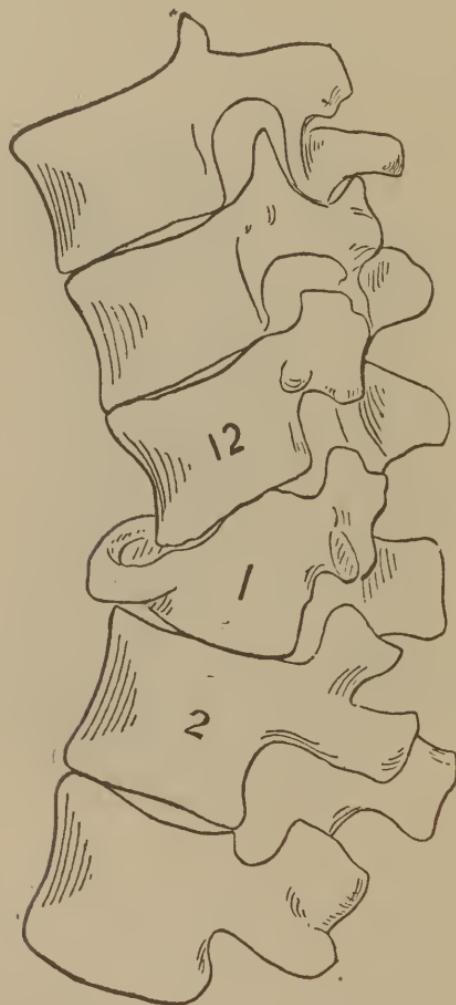


PLATE XI.

(No. 941 WARREN MUSEUM.)

Fracture of 1st lumbar vert. Female, æt. 19; fall, 20 ft., striking on nates. Spinal canal encroached upon. Symptoms.—Complete paralysis, immediate. Results.—Moderate improvement after 3 weeks; power of sphincters regained.

used several times in a similar manner at Bellevue Hospital with very satisfactory results, and says that probably others also have used the plaster jacket in this way. However this may be, Dr. Weist made the report at the

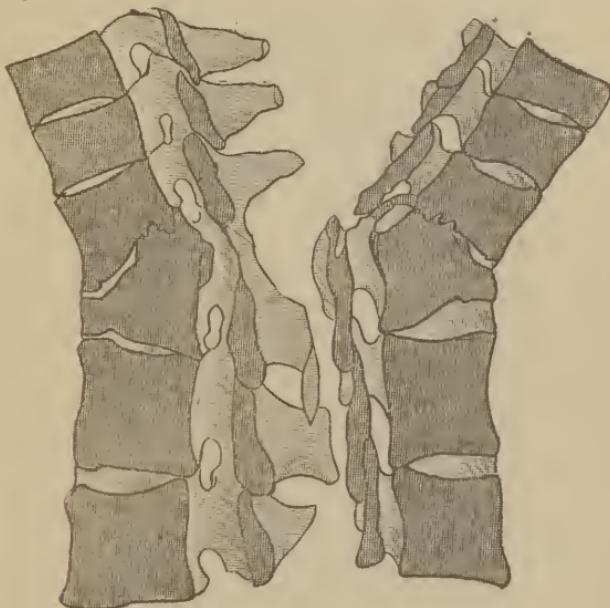


PLATE XII.

(NO. 4629 WARREN MUSEUM.)

Old fracture 12th dorsal. Upper edge has been broken away from body of centrum. 12th dorsal vertebra is crushed anteriorly. Considerable narrowing of canal, opposite upper edge of 12th dorsal vertebra.

C. A., æt. 18; fell on plank floor. Paralysis, bed sores, cystitis; death after 2 8-12 years. Cord considerably disorganized at seat of injury.

request of Professor Sayre, and with the exception of an allusion to a case of Spratley's by Reginald Harrison, shown at the Liverpool Medical Institution,¹⁹ Dr. Weist's case is the earliest published record of the procedure that I have been able to find.

¹⁹ Surgical Diseases of the Urinary Organs (Lectures on), p. 51, by R. Harrison, at the season 1878-9.

In the remainder of the year 1879, I find five cases treated in this manner. König, of Gottingen, in 1880 said that having used suspension and plaster of Paris jackets for caries of the vertebræ, where there was paralysis,



PLATE XIII.

(No. 938 WARREN MUSEUM.)

Fracture 4th dorsal: longitudinal section, showing backward displacement and narrowing of canal. Female, ag. 25; fall, 15 feet; paralysis (complete); bed sores; death, 9 weeks.

with great improvement, he was led to apply a similar treatment to fresh fractures of the spine. He did not advocate its employment in all cases, but in his three cases the results were favorable. (See Appendix II.)

He said that doubtless the method had been employed in other hospitals, and he wrote the paper as a contribution to the subject. Wagner, of Königshutte, reported two cases with which he was not at all satisfied. In both cases he was obliged to remove the jacket. (See Appendix III.) He advised caution in the use of the jacket, had seen it produce paralysis, and felt that the replacement might produce alarming or dangerous symptoms. He advocated its application at the expiration of fourteen days. The whole subject was discussed at the German Congress of Surgeons in 1881,²⁰ and was evidently considered a measure worthy of trial in picked cases. Langenbeck mentioned a case which he had treated in this manner in 1862, and which ended in failure. Since then I have accounts of the following cases: one by Berkeley Hill (see Appendix IV.); one by Edouard de Reynier (see Appendix V.); one by Carson (see Appendix VI.); two cases by H. O. Marcy, private letter (see Appendix VII.); and the five cases included in Table F.

No attempt has been made to investigate cases where a jacket has been applied after the tenth day following an injury. This gives us sixteen cases, in which three died, three derived no benefit from the method, and ten were greatly benefited.

The subject may be summarized, and I submit the following conclusions:

First—That, in the *immediate* correction of the deformity and fixation with plaster of Paris jacket or other means, we have a rational method of treating a large number of cases of fractures of the spine.

²⁰ Berl. Klin. Wochens., 1881, p. 247.

Second—That, considering the hopelessness of results in fracture of the spine when treated expectantly, almost any risk is justifiable.

Third—That the *immediate* correction of the deformity is imperative, *if* softening of the cord can and does occur from pressure at the end of forty-eight hours.

Fourth—That the suspension of the patient is only a means of rectifying the deformity; that certain fractures could be simply pressed into position while the patient lies prone or supine.

The objections to the treatment are,—

1st. That the expectant plan of treatment gives a small percentage of recoveries.

2d. That there are serious risks, especially in the cervical region, attending the suspension of a patient and the rectification of the deformity with a fractured spine, in the way of shock, collapse and death.

3d. That in attempting to relieve pressure on the cord, by rectifying the deformity, we might either sever the spinal cord or make pressure upon it. This is a matter of chance.

My own belief regarding the status which the procedure should occupy in Surgery is, that it will occasionally be a life saving measure; that it should be applied under anaesthesia in all cases of fracture of the spine, which are not conclusively known to be irremediable; and that apart from the chance of recovery offered to the patient by this means, it will almost invariably make the patient more comfortable, in that he can be handled more easily.

In conclusion I wish to acknowledge my indebtedness to Drs. H. W. Cushing, E. G. Brackett and W. H. Prescott for valuable assistance rendered in preparing details of this paper.

(Table H.) TABLE OF RECOVERIES.

| NUMBER. | NAME. DATE. REFERENCE. | AGE. | SEX. | SURGEON. | CHARACTER OF ACCIDENT. | SEAT OF INJURY. | CREPIUS. | DEFORMITY. | UNCONSCIOUS- NESS. | PARALYSIS. | PAIN. | PRAPIASM. | DELIRIUM. | CYSTITIS. | BED SORES. | DEATH. | AUTOPSY. | REMARKS. | |
|---------|---|------|------|------------|---|--|----------|------------|-----------------------|--|-------|-----------|-----------|-----------|------------|--------|----------|--|--|
| 1 | N. K. Jan. 30, 1866, vol. 8, p. 152. | 14 | F | Coolidge. | Fell 3 weeks before entrance. | Lumbar. | yes | | | | | | | | | | | | Treatment—rest in bed. Discharged relieved, Feb. 16, 1866. |
| 2 | J. R. June 20, 1867, vol. 11, p. 136. | 30 | M | Cheever. | Fell from mast head. | Fracture of spinous pro- cess in lum- bar region. | yes | | | Retention, Constipation. | yes | | | | | | | | Discharged well in one month. |
| 3 | W. K. Oct. 29, 1870, vol. 32, p. 24. | 19 | M | Fifield. | Fall from ladder. | 1st dorsal. | yes | no | no | Yes. | yes | no | no | no | no | no | no | Discharged Dec. 24, 1870, nearly well; nothing especial done. | |
| 4 | II. W. Oct. 2, 1874, vol. 53, p. 211. | 50 | M | | Fall 25 feet. | Lower dorsal. | yes | yes | no | Complete. | yes | | yes | yes | yes | | | Some nausea and vomiting; tympanites; puracentesis abdominis; involuntary defecations; bed sores on left flank and thighs, exposing muscles; catheter kept in bladder. Heavy drinker. Discharged relieved, Dec. 30, 1874. No record of paralysis; bed sores clean and small. | |
| 5 | D. F. Dec. 3, 1874, vol. 55, p. 162. | 55 | M | Gay. | Buried in débris by giving way of a floor. | Lower dorsal. | yes | yes | no | Complete. | yes | | yes | yes | | | | Tympanites; incontinence of urine; diarrhoea; became fretful; circulation poor; no improvement in paralysis. Discharged relieved. | |
| 6 | J. E. Feb. 26, 1878, vol. 76, p. 130 | 38 | M | Thorndike. | Fell down 4 steps, striking on head and shoulders. | Cervical. | yes | yes | no | Partial, at first. | yes | | | | | | | Paralysis of arm, hand and leg at once, lasting 12 hours; gradual return of sensation; probable fracture of spinous process. Discharged March 23, 1878, relieved. | |
| 7 | P. W. June 21, 1881, vol. 95, p. 136. | 32 | M | Ingalls. | 5 weeks before entrance fell quite a distance. | Lumbar. | yes | | | Complete. | yes | | yes | yes | | | | Discharged in one month, condition unchanged; incontinence of faeces and urine. | |
| 8 | F. D. Sept. 2, 1882, vol. 106, p. 221. | 34 | M | Thorndike. | Fell 2 stories. | Lumbar, 4th. | yes | yes | no | Complete. | yes | | no | yes | yes | | | Tympanites; involuntary defecations; reflexes increased; considerable twitching; "girdle" sensation; urethritis. Treatment, fracture bed. Oct. 14, 1882, motion in legs. Nov. 9th, sat up. Nov. 13, discharged, condition relieved. Seen on Oct. 1, 1886. Staid in house 3 yrs. 8 mos., going about on crutches; retention for 5 mos.; incontinence of faeces 2 years. Present condition—slight incontinence; can go down stairs fairly well with crutches; can move r. leg fairly, but subjectively heavy; almost complete motor paralysis of l. leg; appetite fair; was very fat for a time; now weight nearly normal. | |
| 9 | T. K. Sept. 13, 1882, vol. 108, p. 18. | 32 | M | Thorndike. | Fell from team, striking on face. | Cervical. | yes | no | no | Absent. | yes | | | | | | | Mounted team and rode home; neck became stiff. Examination—head carried low; crepitus on lateral pressure of transverse processes of 5th & 6th cerv. vert. Sept. 14, 1882, p. of P. jacket, with a hood about head; back fixed with ham splint, attached with shoulder cap over head, after partial removal of plaster. Sept. 29, 1882, "bound to go"; plaster removed; projection felt over 5 & 6 cerv. spines; some tenderness; moves head easily. No further symptoms. | |
| 10 | R. B. Oct. 5, 1882, vol. 108, p. 87. | 29 | M | Fifield. | Was caught between the seat of a team and the top of a driveway. | Lumbar, 1st & 2d. | no | yes | no | Absent at first, slight numbness later. | yes | | | | | | | Delirium tremens on 4th day. Discharged Nov. 1, 1882, nearly well; projection plainly felt. | |
| 11 | S. C. Oct. 5, 1883, vol. 116, p. 92. | 33 | M | Fifield. | Fell 14 feet, striking head. | Spine of 6th cervical. | yes | no | no | Absent. | yes | | | | | | | Discharged well in 6 weeks; plaster hood applied 3d day. Letter, May 16, 1887, does light work on a farm. | |
| 12 | M. C. Nov. 23, 1883, vol. 115, p. 165. | 40 | M | Cheever. | Thrown from a team. | Upper Lumbar. | yes | yes | no | Complete. | yes | no | yes | yes | | | | Dec. 22, 1883, thinks he can do as well at home as in hospital; discharged, own request, unrelieved. | |
| 13 | W. R. July 7, 1884, vol. 122, p. 159. | 45 | M | Homans. | Thrown from railroad bridge. | Dorsal, 4th & 5th. | yes | yes | For a few minutes. | Absent. | yes | | | | | | | Lobar pneumonia 36 days after entrance. Treatment—fracture bed, swathe round body. Discharged, well, Aug. 30, 1884. May 18, 1887, walks about, and does a little work. | |
| 14 | | | | | | | | | | | | | | | | | | (See Table for Immediate Rectification of Deformity and Fixation by P. of P. Jaeket.) | |
| 15 | F. W. Sept. 20, 1885, vol. 130, p. 256. | 36 | M | Bolles. | Fell 3 stories. | Mid dorsal. | yes | no | no | Complete. | yes | | yes | yes | | | | Letter from patient Sept. 15, 1886. Can move legs slightly, but not to any practical extent; sensation fairly good; catheter constantly; scrotum and penis often oedematous; general condition improving, but bed-ridden. | |
| 16 | W. C. Oct. 18, 1885, vol. 132, p. 66. | 25 | M | Post. | Fell 35 feet, 1 week before entrance. | Dorsal, 4th. | yes | | | Complete. | yes | | yes | yes | | | | Discharged incurable. | |
| 17 | | | | | | | | | | | | | | | | | | (See Table for Immediate Rectification of Deformity and Fixation by P. of P. Jaeket.) | |
| 18 | | | | | | | | | | | | | | | | | | " " " " " " " " " " " " " " " | |

APPENDIX.

I.

From the St. Louis Medical and Surgical Journal.

FRACTURE OF THE SPINE, WITH CASES. By T. R. WEIST, M.D., of Richmond, Indiana, March, 1880, p. 295.

ON June 25, 1879, called to see Mr. B., farmer, aet. 30, whose back, messenger said, "was broken." When accident occurred, he was on top of a load of hay, that was being driven under a shed across which some beams were placed. While passing through, he found that he was likely to be caught by the timbers above. He was sitting on the hay; he threw his body forward and lowered his head; still there was not sufficient room, and the upper part of his shoulder and spine came in contact with the obstruction above, and he was badly crushed. Was unconscious for some time after the accident. There was a serious injury and great deformity of back. A few hours later he was in great agony, complaining of violent pain in his back, and of great difficulty in breathing.

Examination:—Shock, pulse 140, feeble, skin cool and perspiring, resp. 35, difficult; deformity of spine at 9th and 10th dorsal vertebræ. On each side of the spine there was a decided swelling near the point of curvature. On shoulders, skin abraded and much bruised. Loss of sensation below seat of injury, more marked on right than on left side. No paralysis of motion. Slightest movement caused great pain. Spinous process of 9th dorsal vertebra was much displaced backwards, it being possible to place the finger under it. Evidently there was fracture of 9th dorsal vertebra, with slight dislocation backwards. Efforts were made by extension and pressure to reduce the displacement, without success. During these manœuvres distinct bony crepitation was felt. Fifteen hours after accident paralysis about the same. He was then suspended à la Sayre. I then made strong extension with slight rotatory movements, and pressure with the other hand over the projecting parts of spine. Crepitation was again felt.

Plaster jacket was now hastily but carefully applied, then he was put to bed. Breathing greatly improved; was left in comparative comfort.

Next day he was much improved; sensation below injury restored; bladder again normal. On 7th day he could turn in bed without assistance; on 12th was carried on a stretcher to his father's house 2 miles distant; on 15th day was able to get out of bed himself; on 20th day a new jacket was applied, and worn until September 1st. November 2d, 67 days after accident (?), his back is as strong as before the injury. . . .

II.

From Centralblatt für Chirurg., Leipzig, 1880, vii. pp. 97-100.

Der Thoraxgipsverband bei Fracturen der Wirbelsäule, von Prof. König. (3 cases.)

(1) Male, æt 20. Had a fall from second story window, Aug. 14th, 1879; unconscious when found. Rallied at hospital. On examin., found a fracture of the 8th dorsal vertebra; there were no symptoms of motor paralysis, no paralysis of either bladder or rectum. On Aug. 16th the plaster of Paris jacket was applied, patient being suspended; the jacket extended from the axillæ to the trochanters. The suspension and application of bandage were well borne, and immediate improvement followed. Patient was able to walk at the end of three weeks. On the removal of bandage, about the middle of the following September, deformity had disappeared, and there were no symptoms of compression of the spinal cord.

(2) Patient, male, æt. 28. Had a fall of 40 feet, Oct. 21, 1879; was unconscious for half an hour, then complained of violent pains in back, and formication in lower extremities, with numbness; no paralysis of bladder or rectum. Back very sensitive in region of first dorsal vertebra; angular deformity at that joint.

Oct. 22d, the gypsum bandage was applied, in the same manner as in the preceding case. The nervous phenomena had disappeared by the next day, and the patient was able to move about by the 22d of November. Nov. 29th bandage was removed; the cyphosis had disappeared, and patient was dismissed perfectly well.

(3) Male, æt. 38. Had a severe fall, Nov. 28th, 1879, from roof of a rail-road car; suffered fracture of 8th, 9th and 10th rib, near vertebral insertion, with haemo-pneumo-thorax deformity (gibbosity) in back, corresponding to the 9th and 10th dorsal

vertebra. On account of symptoms of embarrassed respiration, the correction of this deformity had to be abandoned. Cervical neuralgia. When the symptoms of embarrassed respiration had about disappeared, the gypsum corset was applied, as in the preceding cases. Nervous phenomena had disappeared the next day; patient continued to improve, and by the end of the year had perfectly recovered.

In all these cases recent fractures were dealt with, and only in such cases would I recommend the application of the gypsum corset.

III.

From Centralblatt für Chir., Leipzig, 1880, vii. pp. 737-739.

Zur Behandlung der Fracturen der Wirbelsäule mit dem Sagréé schen Gipskorsett, von W. Wagner. (2 cases.)

The author refers to the good results obtained by Prof. König in his 3 cases, and then reports two cases with which he is not satisfied:—

(1) Male, aet. 38. On Oct. 16th, 1879, was buried beneath a mass of coal, which fell upon his back; was immediately removed to hospital. There was evidently fracture of the 11th dorsal vertebra. Paralysis of bladder, which was temporary, and disappeared within 24 hours; no motor or sensory disturbances; "gibbosity," or displacement of fragments, in back. The next day patient was suspended "to toes only" (!); the "gibbosity" disappeared somewhat, but the patient complained of violent pains near the seat of fracture during the suspension. The plaster of Paris jacket was applied. During the next twenty-four hours, the pain had so greatly increased, that the patient was actually frenzied, so that the bandage had to be removed, when the pains immediately abated, and the patient afterwards recovered.

(2) Male, aet. 25. Jan. 31, 1879, sustained a great pressure while in a bent position; fracture of the 10th dorsal vertebra; no disturbance of mobility; deformity in back.

The plaster of Paris jacket was applied 24 hours after reception of injury, and was well borne at first; deformity disappeared; no increase of pain. The next day the patient complained of numbness in his lower extremities; when examined, perfect paralysis of extremities was found, also paralysis of bladder, necessitating use of catheter; decreased sensibility of extremities also found. The bandage was at once removed; all the disturbances mentioned disappeared in the course of a week. At the end of that time, patient complained of severe pains at seat of fracture when he attempted to sit up in bed. Another bandage was applied; this was worn for three months, when the patient was dismissed with slight deformity.

IV.

*From Transactions of Clinical Society of London, 1881, vol. xiv.
pp. 141-147.*

CASE OF BERKELEY HILL, read March 11th, 1881, before Clinical Society of London.

John Richards, on Dec. 1st, 1880, fell 20 feet down an elevator. He was unconscious until he found himself in the hospital. On his way to Univ. College Hosp. he had two fits. Never remembers having any before the accident. Suffered for 24 hours from concussion of brain and spinal cord, and was unconscious for half an hour after admitted to the hospital. Pupils dilated and insensible to light; skin hot and sweaty; pulse 120. Respiration frequent, shallow and puffing. A severe contusion behind the right parietal eminence was the only sign of injury to skull.

In the back, there was prominence of the spinous processes from the 10th dorsal to 2d lumbar vertebra; a large swelling occupied the vertebral grooves. No symptoms of visceral injury; urine drawn from bladder, normal; no paralysis of lower extremities, but great pain on movement. At 7 A.M., next day, temperature 103°; no retention of urine, no paralysis, but great pain in back. At 2 P.M., same day, the jacket (plaster of Paris) was applied; it gave great pain until it had firmly set; patient was kept until then on air-bed. The temperature then fell, patient asked for food, and then slept. Third day after application of jacket patient could roll himself in bed from side to side without pain.

Dec. 4th, patient complained of sharp pain on dorsum of left foot; no loss of sensibility anywhere. Dec. 5th, could not move the lower extremity at hip, knee or ankle, though he could flex the toes slightly. Right limb normal; but sensation of "pins and needles" in fingers of right hand. In two days control of left limb was regained, hyperæsth. of foot disappeared. Jan. 27th, jacket removed, patient allowed to walk about the ward. Feb. 2d, patient left for Eastbourne Hospital (a long railway ride). Feb. 24th, completely cured and able to walk three (3) miles.

V.

From Deutsche Z'schrift. f. Chirur., Leipzig, 1885, xxii. pp. 356, 386, by EDWARD DE REYNIER.

FRACTURE OF 7TH DORSAL VERTEBRA.

Patient was suspended "à la Sayre;" perfect reduction of dislocation in this position; plaster of Paris jacket was then applied, in order to insure "permanent reposition" of spine.

The injury had caused paralysis both of motion and sensation in lower extremities, which had completely disappeared eight days after application of jacket. One month later patient was able to rise and walk, with the aid of crutches. He wore the jacket for two months, at the expiration of which he left the hospital cured.

Title of article is: *Einige Bemerkungen über 17 Fälle von Wirbelfrakturen, die auf der Chir. Klinik zu Bern vom Jahre, 1865–1884 vorgekommen sind*, von EDOUARD DE REYNIER.

Patient, male, æt. 19. Admitted to hospital, Sept. 20th, 1881, for fracture of spine (exact location not mentioned); had fallen into a well head first, had his back suddenly thrust backward; states he "heard his back crack." He was then unable to rise or move and was brought to the hospital in this condition. Author regrets to say that he was only thoroughly examined five days after the infliction of the injury. Plaster jacket was not applied until Oct. 3d; the next day the sensibility and power of motion had returned, and retention of urine disappeared (no priapism).

VI.

From St. Louis Courier of Medicine, Jan. 1885, p. 71.

Meeting of "St. Louis Medico-Chirurgical Society." Dr. Carson (N. B.); "It may be interesting to the gentlemen here who were present several weeks ago, when I reported a case of fracture of the spine, to hear the result. I saw the patient shortly after the receipt of the injury, within a very few hours, and applied a plaster jacket; the patient was at that time devoid of sensibility and ability to move the extremities. I stated that immediately after the stretching he felt relieved from the pain, and all the other symptoms were also relieved; the fracture was in the lower portion of the dorsal region. The patient gradually recovered, and the bad symptoms disappeared within a few days after the application of the splint, as did the other disagreeable symptoms, and he said to me to-day that he felt as though he could go out. I don't think he could run a race, but I think he has done very well indeed."

We have had, since that time, another case, which happened very much in the same manner, and the injury is very nearly at the same site. The patient came to the hospital several days after the injury was received, in a much worse condition. We applied the jacket in this case, but not with any decided improvement, so far. The patient was unable to talk or feel the introduction of the catheter at the time he entered the hospital. At

the present time, whenever the catheter is introduced, he feels it, but there is total loss of sensation in the lower extremities, and his condition is not a favorable one, nor has there been any material benefit by the application of the splint. In this case, however, we did not suspend him as we did in the other; we tried extension and counter-extension from the hip and shoulder in the horizontal position."

VII.

W. L., *aet.* about 50. Carpenter, strong and vigorous. Fell from staging, about thirty feet, May 21, 1881.

Was doubled up and taken home in a back. I saw him soon after. Fracture of spine near middle dorsal. Paralysis complete. Priapism, retention of urine. Motion of fragments marked at point of injury. After a careful explanation of the danger, extension was made and a plaster splint applied, aided by Dr. Samuel N. Nelson. For a few days there was a marked improvement, both sensation and motion in a slight degree returning to both extremities. Soon the patient grew worse, with rapid pulse, elevation of temperature, delirium, sinking into a coma, and death supervened June 4th, fourteen days after the injury.

Autopsy showed a transverse fracture through the body of the vertebra with local softening of the cord at the place of injury. The fragments were in direct apposition.

CASE 2d.—P. R., horse doctor, *aet.* about 50. In good general health, except suffering from multiple strictures. Had been a hard drinker.

In August of 1882, was thrown backward from carriage, striking violently on shoulders. Paralysis not complete. Sensation and motion of lower extremities, to a limited extent; retention of urine. Not seen for some days after injury, owing to absence from city; under care of another physician. Was a distinct projection with marked tenderness over the second and third dorsal vertebrae, with slight motion on firm pressure. In consultation with Dr. F. A. Holt, of Cambridge, it was determined to attempt extension and reduction, after a careful explanation, of the condition and its danger, to the patient.

Upon extension a certain amount of displacement was effected and a plaster splint applied. The patient fainted, with entire loss of consciousness at its completion, but rallied at once upon being placed horizontal on a water bed near at hand. Owing to pressure and disturbed respiration the splint was carefully opened anteriorly, and retained by tapes. Was kept on water bed three

weeks, and then carefully removed to a firm hair mattress. Paralysis slowly lessened, until patient could walk, at the end of about six months. Now is able to attend to business. Can stand upon either foot and has no pain or tenderness at seat of injury. The patient is stooped, with a considerable prominence at site of injury, and carries the head somewhat forward.



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